SURVEY-POINT DISPLAY APPARATUS AND SURVEY-POINT DISPLAY PROGRAM RECORDING MEDIUM

Japanese Patent Publication No. 3261359
Published on: December 14, 2001
Application No. Hei-10-362162
Filed on: December 21, 1998
Inventor: Seitaro TAMASHIMA
Inventor: Kosuke KAMEI
Patent Attorney: Shuichiro KITAMURA

SPECIFICATION

[TITLE OF THE INVENTION]

Survey-point display apparatus and survey-point display program recording medium

[WHAT IS CLAIMED IS;]

[Claim 1] A survey-point display apparatus comprising:

receiving means for continuously or intermittently receiving positional data about a survey point;

display means for displaying a position of the survey point on a predetermined display screen by sequentially processing the positional data received by the receiving means;

and

positional data storage means for storing the positional data corresponding to the position of the survey point displayed on the display screen specified by an input operation of an operator in a storage device;

wherein each position of at least three of the survey points corresponding to the most recent positional data received by the receiving means and to at least two pieces of positional data received within a fixed period preceding it is simultaneously displayed on the display screen by dot marks having specified-sizes that become smaller in order from the most recent one, and the positions of at least three survey points are displayed so that a before-and-after relationship among respective surveying time points can be recognized.

[Claim 2] A survey-point display apparatus as set forth in Claim 1, wherein the positional data received by the receiving means are sequentially stored in the storage device at regular intervals of time regardless of whether the input operation has been performed or not after the input operation, and

a fixed period elapses after the receiving means has received them, and the positional data not stored are deleted.

[Claim 3] A survey-point display apparatus as set forth in Claim 1 or 2, wherein the position of the survey point

corresponding to the positional data stored in the storage device is displayed on the display screen.

[Claim 4] A survey-point display apparatus as set forth in Claim 1, 2, or 3, wherein the positions of the plural survey points corresponding to the most recent positional data received by the receiving means and to at least one piece of positional data received within the fixed period preceding it are simultaneously displayed on the display screen.

[Claim 5] A survey-point display apparatus as set forth in Claim 4, wherein the positions of the plural survey points are displayed so that a before-and-after relationship among respective surveying time points can be distinguished.

[Claim 6] A survey-point display apparatus as set forth in Claim 1, 2, 3, 4, or 5, comprising indicating means for indicating an arbitrary position on the display screen, and circular-rule display means for displaying a circular rule having a predetermined radius centering on a position indicated by the indicating means on the display screen.

[Claim 7] A program recording medium for storing a survey-point display program to be executed on a computer configured so that positional data about a survey point surveyed by a surveying instrument can be continuously or intermittently received through a built-in or external communications terminal

and to realize the survey-point display apparatus as set forth in Claim 1, 2, 3, 4, 5, or 6 by the computer.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Field of the Invention] The present invention relates to a survey-point display apparatus for displaying the position of a survey point surveyed by a surveying instrument, such as an electro-optical distance meter or a GPS (Global Positioning System) surveying instrument.

[0002]

[Prior Arts] Conventionally, in this type of survey-point display apparatus, positional data about a survey point has been stored under each instruction as to measurement, and the position of the survey point has been displayed on an image display apparatus attached to or externally connected to a surveying instrument when the distance and angle from a reference point to the survey point are measured by the use of an electro-optical distance meter, for example. In the GPS surveying instrument, positional data about survey points continuously surveyed have all been received and stored, and the positional data about the survey points have been received at regular intervals and have been stored. In other words, the positional data have all been stored to display the positions

of the survey points.

[0003]

[Problems to be Solved by the Invention] However, a conventional problem resides in that if a survey point is a movable body, a long surveying time interval makes it impossible to accurately reproduce the movement locus of the movable body, and makes it impossible to accurately understand the traveling direction of the movable body. Additionally, although the aforementioned problem can be resolved by shortening the surveying time interval and increasing the number of survey points, the result of storing needless survey data is brought about, and a memory capacity for storing survey data becomes huge.

[0004] The present invention has been made in consideration of the aforementioned circumstances, and aims to provide a survey-point display apparatus by which both the accurate display and reproduction of survey points and the effective storage of survey data become compatible.

[0005]

[Means for Solving Problems] A first feature configuration of the survey-point display apparatus according to the present invention to achieve this object exists in the fact that, as set forth in Claim 1 of the patent claims, it comprises receiving

means for continuously or intermittently receiving positional data about a survey point; display means for displaying a position of the survey point on a predetermined display screen by sequentially processing the positional data received by the receiving means; and positional data storage means for storing the positional data corresponding to the position of the survey point displayed on the display screen specified by an input operation of an operator in a storage device; wherein each position of at least three of the survey points corresponding to the most recent positional data received by the receiving means and to at least two pieces of positional data received within a fixed period preceding it is simultaneously displayed on the display screen by dot marks having specified-sizes that become smaller in order from the most recent one, and the positions of at least three survey points are displayed so that a before-and-after relationship among respective surveying time points can be recognized.

[0006] A second feature configuration exists in the fact that, as set forth in Claim 2 of the patent claims, it comprises receiving means for continuously or intermittently receiving positional data about a survey point; display means for displaying a position of the survey point on a predetermined display screen by sequentially processing the positional data

received by the receiving means; and positional data storage means for storing the positional data corresponding to the position of the survey point displayed on the display screen specified by an input operation of an operator in a storage device; wherein the positional data received by the receiving means are sequentially stored in the storage device at regular intervals of time regardless of whether the input operation has been performed or not after the input operation, and a fixed period elapses after the receiving means has received them, and the positional data not stored are deleted, in addition to the first feature configuration. Herein, the survey point is an object to be surveyed, which is a movable body or a stationary body. Therefore, the positional data about survey points may be positional data showing the positions of the same movable body changing time-dependently or may be positional data showing each position of a plurality of stationary points.

[0007] A third feature configuration exists in the fact that, as set forth in Claim 3 of the patent claims, the position of the survey point corresponding to the positional data stored in the storage device is displayed on the display screen, in addition to the first or second feature configuration.

[0008] A fourth feature configuration exists in the fact that, as set forth in Claim 4 of the patent claims, the positions

of the plural survey points corresponding to the most recent positional data received by the receiving means and to at least one piece of positional data received within the fixed period preceding it are simultaneously displayed on the display screen, in addition to the first, second, or third feature configuration.

[0009] A fifth feature configuration exists in the fact that, as set forth in Claim 5 of the patent claims, the positions of the plural survey points are displayed so that a before-and-after relationship among respective surveying time points can be distinguished, in addition to the fourth feature configuration.

[0010] A sixth feature configuration exists in the fact that, as set forth in Claim 6 of the patent claims, it comprises indicating means for indicating an arbitrary position on the display screen, and circular-rule display means for displaying a circular rule having a predetermined radius centering on a position indicated by the indicating means on the display screen, in addition to the first, second, third, fourth, or fifth feature configuration.

[0011] A feature configuration of a survey-point display program recording medium according to the present invention to achieve this object exists in the fact that, as set forth in Claim 7 of the patent claims, it stores a survey-point display

program to be executed on a computer configured so that positional data about a survey point surveyed by a surveying instrument can be continuously or intermittently received through a built-in or external communications terminal and to realize the survey-point display apparatus as set forth in any one of Claims 1 through 6 by the computer.

[0012] The operation and effect will be described hereinafter. According to the first feature configuration of the survey-point display apparatus according to the present invention, the present location (most recent position) and the traveling direction of the movable body can be obviously recognized by the size of the dot mark on the display screen.

[0013] According to the second feature configuration of the survey-point display apparatus according to the present invention, the receiving means receives the positional data about the surveyed survey points with short time intervals if the object is a movable body and by shortening the distance between survey points close to each other if the object is a stationary body, and the display means can temporarily display the positions of all survey points on the display screen on the basis of the positional data, and therefore a high-resolution survey result can be ascertained on the display screen, and, as a result, survey points to be stored can be stored by the

positional data storage means while ascertaining them on the display screen. Therefore, economically, there is no need for the memory capacity of the storage device to use a high-capacity. Herein, the survey point to be stored means a survey point such that the positions of survey points deleted without being stored can be interpolated only by those survey points with predetermined precision. Therefore, unlike a case where survey points to be stored at regular intervals are simply specified, even when the movable body, for example, suddenly changes its course, the operator can store the position of the course change while judging it as a survey point to be stored. As a result, a survey result can be reproduced with excellent precision only by the thus stored positional data about the survey point. Further, according to the second feature configuration, for example, when the movable body is moving while gradually changing its course, a movement locus therebetween can be interpolated by the survey points stored at regular time intervals without allowing the operator to specify a survey point to be stored, and therefore all that is needed for the operator is that the operator simply specifies only the point of an abrupt course change where an interpolation error becomes great when survey points stored at regular intervals are specified, and thereby the labor time of the operator is greatly reduced.

[0014] According to the third feature configuration, even if the display means displays only the most recent survey point that has been received on the display screen, the positions of survey points surveyed until then can be understood. Therefore, the amount of positional data to be temporarily stored while the display means is displaying it on the display screen can be reduced, and the configuration of a temporary storing means of the display means can be simplified.

[0015] According to the fourth feature configuration, since the positional relationship between a survey point most recently displayed and a survey point close to it can be visually judged easily, an easy judgment can be formed as to whether they are survey points to be stored or not. Further, since survey points other than the survey point most recently displayed can be specified as survey points to be stored, it obviates the necessity of quickly judging whether they are survey points to be stored or not, and the usability of the operator is improved.

[0016] According to the fifth feature configuration, if the survey point is a movable body, the traveling direction of the movable body can be easily understood. In other words, even if the positions of a plurality of survey points are displayed on the display screen, the operator is not required to individually memorize which one of the survey points has

been displayed as the most recent one if the interval of the receiving time of positional data is long. It is effective especially when the display screen is changed in screen size or is changed while being scrolled.

[0017] According to the sixth feature configuration, the distance between a survey point and another survey point can be immediately judged, and, if the survey point is a movable body, the distance to an obstacle or to a predetermined course can be immediately judged by a circular rule. In other words, this distance can be roughly calculated only by moving the center of the circular rule by the indicating means, and therefore it can be calculated faster than a case where the distance between a survey point and an object is measured by specifying two points corresponding thereto on the display screen or a case where a rough calculation is made using the grid display on the display screen as a target, and therefore it is suitable to measure the distance between the movable body moving at high speed and an obstacle or a predetermined course, and it is superior in measuring accuracy to a case where a rough calculation is made using the grid display on the display screen as a target.

[0018] According to the feature configuration of the survey-point display program recording medium according to the present invention, since the first, second, third, fourth, fifth,

or sixth feature configuration of the survey-point display apparatus according to the present invention can be realized on this computer by loading this program from the recording medium to an executable computer or by directly accessing this recording medium, an operational effect identical to the operational effect given by the first, second, third, fourth, fifth, or sixth feature configuration can be brought about.

[0019]

[Preferred Embodiments of the Invention] On the assumption that a survey point resulting from the surveying of the position of a movable body, such as a ship, is displayed, embodiments of a survey-point display apparatus according to the present invention (hereinafter, referred to as the apparatus of the present invention) will be described with reference to the drawings. As shown in FIG. 1, the apparatus of the present invention is made up of a receiving means 2 communicatably connected to at least one surveying instrument 1 for continuously or intermittently receiving positional data D about a survey point surveyed by these surveying instruments 1, a display means 4 for subjecting the positional data D received by the receiving means 2 to data conversion, then calculating the predetermined display position on a display screen of the position of the survey point, and displaying it on an output means 3, such as

a CRT display device, together with a reference figure, such as a map, an input means 5, such as a keyboard or a mouse, and a positional data storage means 7 for specifying the position of the survey point displayed on the display screen by the input operation of an operator from the input means 5 and then storing the positional data D corresponding to the position of the specified survey point on a nonvolatile storage device 6, such as a magnetic disk.

[0020] In greater detail, that is configured by applying a general personal computer thereto, and a transmission control part of the receiving means 2, the display means 4, and the positional data storage means 7 realize the apparatus of the present invention by executing a predetermined program on the personal computer. It is permissible that this program is fixedly stored in a storage device, such as a magnetic disk, included in a personal computer, or it is permissible that data stored in a recording medium, such as a CD-ROM or a floppy disk, is transferred to this storage device and is used at the correct time. Additionally, it is permissible that this storage medium is used such that a microprocessor directly accesses it if the operating speed of the recording medium has high speed properties and random access properties equivalent to the main memory of the personal computer.

[0021] If the surveying instrument 1 is a GPS surveying instrument or the like, and is mounted on a ship, and the apparatus of the present invention is on land, or if the surveying instrument 1 is a transit including an electro-optical distance meter or the like and is disposed on land, and the apparatus of the present invention is disposed in a ship, it will be convenient for the apparatus of the present invention and the surveying instrument 1 to use radio communications, and therefore the receiving means 2 has a radiocommunications terminal. If the surveying instrument 1 and the apparatus of the present invention are juxtaposed and are used on a ship or on land, the receiving means 2 has a cablecommunications terminal that connects the apparatus of the present invention to the surveying instrument 1 through a communications cable according to a predetermined communications method, such as RS-232C standard compliance.

[0022] Next, a description will be given of the operation of the display means 4 and the positional data storage means 7. When the positional data D is input from the receiving means 2, the display means 4 temporarily stores this positional data D in a predetermined storage area. At most N pieces of positional data D about survey points input in the past are stored in this storage area. Identification numbers that show the input order

of 1 to N from new data in the order of input are allocated to each positional data. Therefore, when new positional data D is input, identification number 1 is given to the new positional data D, and is stored in the storage area, and each of the identification numbers of the positional data D that have already been stored receives the addition of 1, and the positional data D whose identification number is N is deleted.

[0023] Continuously, the data conversion of the positional data D whose identification number is 1 is performed, and a coordinate value of the display position on the display screen is calculated. The calculation concerning the positional data D whose identification number is 2 or greater has already been completed, and a calculation result is temporarily stored in a predetermined storage area. Therefore, in the positional display of the N pieces of survey points on the display screen, a dot mark having a size specified by an identification number is displayed at the position of the coordinate value. As shown in FIG. 2, the size of the dot mark is set to become smaller proportionately with an increase in the identification number. As a result, the present location and the traveling direction of the movable body can be obviously recognized by the size of the dot mark on the screen. Thus, the position of a new survey point is additionally displayed by a maximum dot mark

whenever new positional data D is input, and the positional display of old survey points has dot marks successively becoming smaller, and finally disappears.

[0024] When the position of a survey point to be stored is displayed, the operator clicks a storage button displayed on the display screen by the input means 5 and specifies positional data D about a survey point corresponding to this positional display while ascertaining the positional display of the survey point on the display screen. Based on the specifying operation, the positional data storage means 7 reads the specified positional data D from the temporary storage area, and control for writing it into the storage device 6 is performed. Further, the positional data storage means 7 starts a built-in counter simultaneously with the specifying operation, and, based on the output of the counter, reads the most recent input positional data D at regular intervals from the temporary storage area, and performs control for writing it into the storage device 6. The counter is reset whenever a new specifying operation is operated, and counting is started. The operator can operate a change and setting of the output time interval of the counter or can operate the deactivation thereof by the menu display on the display screen and by the operation of the input means 5. The display screen, the storage button, the menu display,

etc., are formed by customizing a graphical user interface attached to the operation system of a commercial personal computer such as Windows 95 (98) of Microsoft Corporation.

[0025] A coordinate value corresponding to the positional data D stored with the aforementioned capacity is stored in the temporary storage area without being deleted even if the identification number exceeds N in accordance with the input of new positional data D. If the identification number of the positional display is larger than N, the display means 4 displays a dot mark different in shape from the aforementioned dot mark on the display screen. Further, as shown in FIG. 2, the display means 4 connects dot marks whose identification numbers are N or larger with a straight line and displays them. As a result, the movement locus of a ship that is a movable body can be clearly displayed on the display screen.

[0026] Another embodiment will be described hereinafter. 〈1〉 The block configuration concerning the data processing of the apparatus of the present invention is shown in FIG. 3. This configuration is an extended one with respect to the basic configuration of the apparatus of the present invention shown in FIG. 1. In the extended apparatus of the present invention, a plurality of surveying instruments 1 are connected to a communications control section 11 through respective

instrument control sections 13. The instrument control section 13 controls the operation of the surveying instrument 1, and, if it is provided on the side of the surveying instrument 1, also controls the transmission of the positional data D to the communications control section 11. If the apparatus of the present invention has the instrument control section 13, each surveying instrument 1 can be operated by central control from the apparatus of the present invention. As assumed cases, there are, for example, a case where there are two or more ships that are movable bodies, and each ship is a surveying ship for measuring the depth of the sea and has a GPS range finder or the like, and a case where a part of the surveying instrument 1 is a depth measuring instrument.

[0027] The communications control section 11 shows a data processing section of the receiving means 2. The display means 4 is made up of a main control section 10, a positional data input/data conversion section 12, a calculation interpolating section 13, a display management section 18, and a data reading section 16. The main control section 10 controls the data flow of each section and the operation of each section, and the positional data input/data conversion section 12 and the calculation interpolating section 13 perform a coordinate-value calculation of display positions of survey

points and perform a calculation to interpolate a space between the display positions by a straight line and display it. The display management section 18 performs the control of screen display, for example, when a plurality of display screens are simultaneously or selectively displayed on the output means 3. For example, a change in each screen size or in the magnification of a display screen or the scrolling of a screen is performed automatically or based on the input operation of an operator from the input means 5. Herein, it is permissible that a plurality of display screens are used for positional display of each ship or are screens different in reduced scale, or it is permissible that one screen thereof displays various measurement values.

[0028] As mentioned above, the data reading section 16 reads positional data D about survey points where positional data D are stored or coordinate values of display positions from the storage device 6 and displays each display position by the dot mark, and uses them for an interpolating calculation for the straight interpolation display mentioned above. In this embodiment, the storage device 6 is a direct readout type memory that can have high-speed random access. Therefore, there is a need to make a backup of the positional data D of survey points separately stored onto a nonvolatile memory 24,

such as a magnetic disk, and a data backup section 23 reads the stored positional data D about survey points from the storage device 6 and backs up the data onto the nonvolatile memory 24. Further, the data reading section 16 is configured to display the position of a survey point loaded to a second direct readout type memory 17 and read data about, for example, reference figures of map data to be displayed.

[0029] The positional data storage means 7 is made up of the main control section 10, a time management section 14, a data write section 15, and the data backup section 23. The main control section 10 controls the data flow of each section and the operation of each section. Under the control of the time management section 14 or based on the specifying operation of positional data D by the input operation of the operator from the input means 5, the data write section 15 writes the positional data D input to the positional data input/data conversion section 12 onto the storage device 6.

[0030] Additionally, it is a preferable embodiment to construct the apparatus of the present invention to include a mail transferring section 25 that transfers the storage content of the storage device 6 by mail, a print control section 19 used for the screen dump of a display screen or used to print the text data of a measurement result, a printer 20, a

synchronizing-signal output control section 21 used to instruct a surveying ship to start surveying, for example, when the position of a survey point reaches a predetermined position, and the signal generating section 22.

[0031] 〈2〉 In the aforementioned embodiment, although the identification numbers are allocated to the plurality of positional data D input to the display means 4, and the dot marks are displayed while changing the sizes thereof, the size of the dot mark is not necessarily required to be changed, and it is permissible to display only the position of a survey point corresponding to the most recent input positional data D. Additionally, it is permissible to flash the dot mark of the most recent input data when the positions of a plurality of survey points are displayed. Further, it is permissible to distinguish the order of input according to another method, such as the use of a FIFO memory, without using the identification number when there is a need to distinguish the order of input.

[0032] 〈3〉 Further, as shown in FIG. 4, it is also preferable to display a circular rule on the display screen. This circular rule C is an auxiliary function of the display means 4, and the center of the circular rule C (indicated by a cross in FIG. 4) is displayed on the display screen by the input operation of, for example, a mouse of the input means

5, and the center can be moved by dragging the mouse. Although the diameter of the circular rule C is predetermined, the set value thereof can be changed. Additionally, the circle of the circular rule C may be two or three concentric circles different in diameter without being limited to a single circle. For example, as shown in FIG. 4 (i), when a judgment is made as to whether the distance between the planned traverse line L of a ship and the position P of the most recent input survey point that is the present location exceeds a predetermined threshold of divergence, it can be easily examined by moving the center of the circular rule C whose radius is equal to this threshold value on a scheduled sea route L and by judging whether the position P falls within the inside of the circular rule C. Additionally, as shown in FIG. 4 (ii), when a judgment is made as to whether the ship is abnormally approaching an obstacle X or not, and when an examination is made as to whether the shortest distance to this obstacle X exceeds a predetermined minimum value or not, it can be easily examined by moving the circular rule C in the state where the circumference of the circular rule C whose diameter is equal to the minimum value is in contact with the outer circumference of this obstacle X and by judging whether the position P falls within the inside of the circular rule C.

[0033] 〈4〉 Further, it is also preferable to specify a movement locus or the like on the display screen by the input operation of, for example, a mouse of the input means 5 and calculate the details for screen display. Additionally, it is also a preferable embodiment to form the configuration so that the display of the plurality of continuous survey points and the display of the circular rule C or planned traverse line L can be changed between display and non-display for every display screen under the input operation of the operator.

[0034] 〈5〉 In the aforementioned embodiment, although a description has been given of a case where the apparatus of the present invention is configured by applying a personal computer thereto, the apparatus of the present invention may be configured by dedicated hardware. Additionally, the survey point may be a movable body other than the ship or may be a stationary body.

[0035] 〈6〉 In the aforementioned embodiment, although a description has been given of the fact that the apparatus of the present invention is used by being connected to an existing range finder, the apparatus of the present invention may be formed to be incorporated into the range finder as a display portion of the range finder. In this case, the receiving means 2 is formed as a receiving circuit that receives the positional

data D merely generated in the inside of the range finder as an internal signal.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1] Block schematic diagram that shows one embodiment of the survey-point display apparatus according to the present invention.

[Fig. 2] Explanatory drawing that schematically shows one example of the display screen.

[Fig. 3] Block schematic diagram concerning data processing that shows one embodiment of the survey-point display apparatus according to the present invention.

[Fig. 4] Explanatory drawing that schematically shows one example when the circular rule is displayed on the display screen.

[Description of Symbols]

1 Surveying instrument

2 Receiving means

3 Output means

4 Display means

5 Input means

6 Storage device

7 Positional data storage means

D Positional data

Fig.1

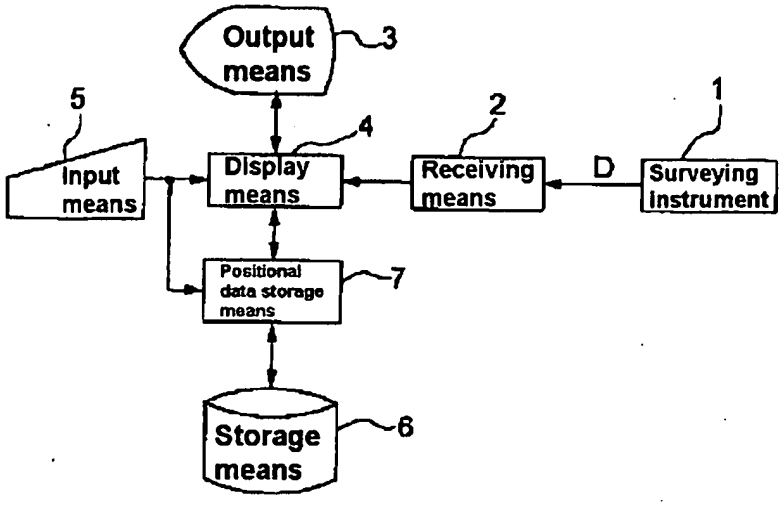

Output means
3
5
4
2
1
Input means
Display means
Receiving means
D
Surveying instrument
Positional data storage means
7
Storage means
6

Fig.2

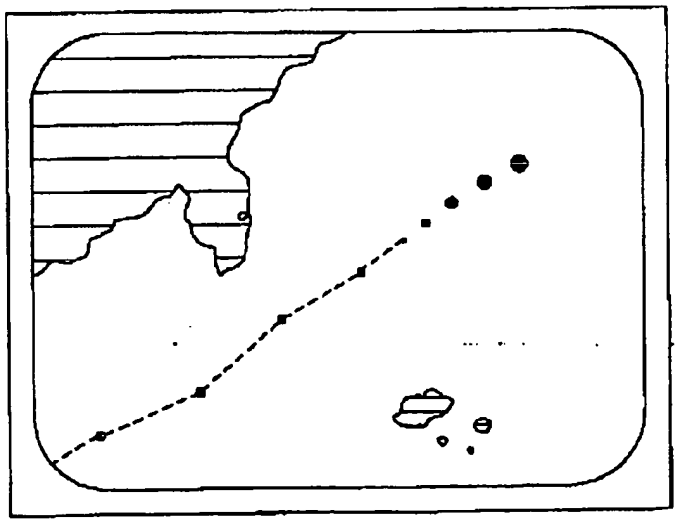
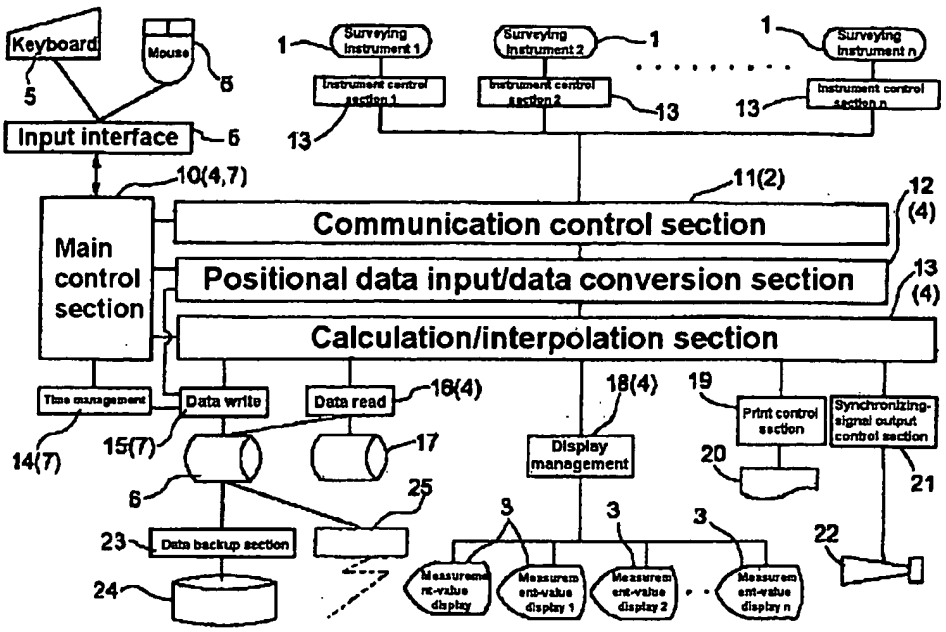


Fig.3



25:Mail transferring section

Fig.4